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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/687,197	10/14/2000	Yutaka Maruo	15.20/5332	9258

24033 7590 06/03/2003

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EXAMINER
DUONG, KHANH B

ART UNIT	PAPER NUMBER
2822	

DATE MAILED: 06/03/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

A-DT

Office Action Summary	Application No.	Applicant(s)	
	09/687,197	MARUO, YUTAKA	
	Examiner	Art Unit	
	Khanh Duong	2822	

-- The MAILING DATE of this communication app ars on the cover sheet with th correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *14 March 2003* .

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-10 and 26-35* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-10 and 26-35* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☒ The proposed drawing correction filed on *14 March 2003* is: a)☒ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

Response to Amendment

This Office Action is in response to the amendment, Paper No. 10, filed on March 14, 2003. Accordingly, claims 11-25 were canceled, claim 1 was amended, and new claims 27-35 were added. Currently, claims 1-10 and 26-35 are pending in the application.

Specification

The amendment filed March 14, 2003 is objected to under 35 U.S.C. 132 because it introduces new matter into the disclosure. 35 U.S.C. 132 states that no amendment shall introduce new matter into the disclosure of the invention. The added material which is not supported by the original disclosure is as follows: Re claims 28, 30 and 35, the limitation "an angle at an intersection between the lower surface of the trench and a side surface of the trench is greater than 90 degrees".

Applicant is required to cancel the new matter in the reply to this Office Action.

Claim Objections

Claim 34 is objected to because of the following informalities: line 3, "the pad layer" should be --the pad insulating layer--. Appropriate correction is required.

Claim Rejections - 35 USC § 112

The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

Claims 28, 30 and 35 are rejected under 35 U.S.C. 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to reasonably

convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention.

Re claims 28, 30 and 35, the limitation "an angle at an intersection between the lower surface of the trench and a side surface of the trench is greater than 90 degrees" is not described in the specification.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1, 3, 6-10 and 27-31 are rejected under 35 U.S.C. 102(e) as being anticipated by Manning (US 5,275,965).

Re claims 1, 27 and 29, Manning discloses a method of manufacturing a semiconductor device (see FIGs. 1-9 and accompanying text) comprising the steps of: forming a pad insulating layer 11 on a silicon substrate 10; forming a nitride polishing stopper layer 12 on the pad insulating layer 11, the polishing stopper layer 12 having a predetermined pattern for a chemical-mechanical polishing; removing a part of the substrate 10 using a resist mask layer 13 including at least the polishing stopper layer 12 as a mask to form a trench, wherein the trench comprises a lower surface and side surfaces in the substrate 10; forming a trench oxide film 21 over a surface of the substrate 10 that forms the trench, wherein the trench oxide film 21 covers the lower surface and side surfaces and comprises rounded corner regions at an intersection of an upper surface of the substrate 10 and the side surfaces of the trench; forming an etching stopper layer

41 (polycrystal silicon, 50 nm) in direct contact with the trench oxide film 21 on the lower surface and side surfaces; filling the trenches with an insulating layer 51 directly contacting the etch stop layer 41, wherein the insulating layer 51 overfills the trench and a portion of the insulation layer 51 extends over the upper surface of the substrate; polishing the insulating layer 51 by a chemical-mechanical polishing; removing the polishing stopper layer 12; etching a part of the insulating layer 51 to form a trench insulating layer; etching a second portion of the insulating layer 51, wherein the etching is controlled so that the second portion of the insulating layer 51 extends to a level above that of the upper surface of the substrate 10 (see col. 3, lines 24-28); and forming an oxide layer 81 on the upper surface of the substrate 10 after etching the insulating layer 51.

Manning discloses that the oxide insulating layer 51 is also etched during the removal of pad oxide 11 (see col. 3, lines 24-28), wherein the polysilicon etching stopper layer 41 appears to be substantially the same, compared with the oxide insulating layer 51, after the etching (see Fig. 7). Therefore, it should be inherent that the oxide insulating layer 51 was etched using an etchant that selectively etches the polysilicon etch stop layer 41 at a rate slower than that of the oxide insulating layer 51.

Re claim 3, Manning expressly shows in Fig. 4 that the etching stopper layer 41 is formed to cover a side surface of the trench oxide film 21.

Re claims 6-8, Manning discloses the etching stopper layer 41 is selected from polycrystal silicon and has a thickness of 500 angstroms (50 nm) (see col. 3, lines 4-15).

Re claims 9 and 10, Manning discloses the steps of thermally oxidizing a portion of the polycrystal silicon layer 41 that protrudes from the surface of the substrate in an element forming

region to form a silicon oxide film; and removing the silicon oxide film at the same time as etching a part of the insulating layer 51 to form a trench insulating layer (see Figs. 8-9; col. 3, lines 32-51).

Re claims 28 and 30, since Manning similarly discloses a conventional etching process to form a trench in the substrate as the instant invention (see col. 2, lines 55-59), it must be inherent that the angle at an intersection between the lower surface of the trench and a side surface of the trench is greater than 90 degrees.

Re claim 31, Manning expressly discloses in FIG. 5 that the etching of the insulating layer 51 is carried out so that a first portion of the insulating layer 51 that extends over the upper surface of the substrate 10 is removed and a second portion of the insulating layer 51 over the trench extends to a level above that of the upper surface of the substrate 10.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

The factual inquiries set forth in Graham **v.** John Deere Co., 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

Claim 2 is rejected under 35 U.S.C. 103(a) as being unpatentable over Manning.

Re claim 2, Manning fails to specifically show a selective etching ratio of the insulating layer 51 with respect to the polycrystal silicon etching stopper layer 41 being 10 or greater.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the process of Manning by selecting an etching ratio of the insulating layer with respect to the polycrystal silicon etching stopper layer within the ranges as required by the claim, since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or working ranges involves only routine skill in the art. In re Aller, 220 F.2d 454, 456, 105 USPQ 233, 235 (CCPA 1955).

Claims 4, 5, 26 and 32-35 are rejected under 35 U.S.C. 103(a) as being unpatentable over Manning in view of Hwang et al. (US 6,329,266).

Re claims 4, 5, 34 and 35, Manning discloses using polycrystal silicon, instead of silicon nitride, as the etching stopper layer.

Hwang et al. suggests using silicon nitride as the etching stopper layer 205 which has a thickness of 30-60 nm for the purpose of reducing subsequent oxidation of the trench inner wall and protecting the trench oxide 204 during a phophoric acid etch of the trench mask layer 202b (see Fig. 7; col. 3, lines 50-53).

Since Manning and Hwang et al. are both from the same field of forming trench isolations, the purpose disclosed by Hwang et al. would have been recognized in the pertinent prior art of Manning.

It would have been obvious at the time the invention was made to a person having ordinary skill in the art to use silicon nitride, instead of polysilicon, as etching stopper layer since

both polysilicon and silicon nitride are considered equivalent materials known in the semiconductor art for protecting the trench oxides.

Re claim 26, Manning fails to show forming the trench oxide layer on the lower surfaces of the trench.

Hwang et al. expressly shows in Fig. 2 the step of forming the trench oxide layer 204 on the lower surfaces of the trench 203 for the purpose of reducing defects in silicon lattices caused by etching of the semiconductor substrate (see col. 3, lines 13-17).

Since Manning and Hwang et al. are both from the same field of forming trench isolations, the purpose disclosed by Hwang et al. would have been recognized in the pertinent prior art of Manning.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the process of Manning with the teaching of Hwang et al. in order to reduce defects in silicon lattices caused by etching of the semiconductor substrate.

Re claims 32-35, Manning fails to show implanting an impurity into a first and second regions of the substrate prior to etching the second portion of the insulating layer 501.

Hwang et al. expressly discloses in Fig. 6 the step of implanting an impurity into regions of the substrate 200 after etching the insulating layer 206 for the purpose of reducing the time needed to remove the active nitride polishing stopper layer (see col. 3, lines 35-45). As shown in Fig. 7, Hwang et al. inherently discloses that the second portion of the insulating layer 206 is also etched during removal of the polishing stopper layer 202b.

Since Manning and Hwang et al. are both from the same field of forming trench isolations, the purpose disclosed by Hwang et al. would have been recognized in the pertinent prior art of Manning.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the process of Manning with the teaching of Hwang et al. in order to reduce the time needed to remove the active nitride polishing stopper layer.

Response to Arguments

Applicant's arguments filed March 14, 2003 have been fully considered but they are not persuasive.

Applicant argues that the Examiner has not cited any portion of Manning that describes or suggests "the etching stopper layer is more resistant to the etching than [the] insulating layer" or "a particular relationship between the etching rate of the poly layer 41 and the etching rate of the oxide layer 51". The Examiner disagrees because Manning discloses that, during the removal of pad oxide 11, the oxide insulating layer 51 is also etched, "but at a much faster rate" as compared to the pad oxide 11 (see Manning, col. 3, lines 24-28). And after such etching, as evidenced by FIG. 7, the polysilicon etching stopper layer 41 appears to be substantially the same, compared with the oxide insulating layer 51. By contrast, as shown in Fig. 29 of the instant invention, Applicant also discloses using a similar polysilicon etching stopper layer 190 which is "barely, if at all, removed by the hydrofluoric acid, compared with the insulating layer 21" (see Specification, page 17, line 25 to page 18, line 5). Since Manning discloses using the same polysilicon etching stopper layer as the instant invention, it is only reasonable to expect that such layer is more resistant to the etching than the oxide insulating layer.

Applicant argues that the basis for combining the teachings of Manning and Hwang is legally insufficient. In response to applicant's argument, the examiner recognizes that obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so found either in the references themselves or in the knowledge generally available to one of ordinary skill in the art. See *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988)and *In re Jones*, 958 F.2d 347, 21 USPQ2d 1941 (Fed. Cir. 1992). In this case, as evidenced by Fig. 7, Hwang expressly suggests that the silicon nitride layer 205 is being used, not only to reduce subsequent oxidation of the trench inner wall, but also to protect the trench oxide 204 during a phophoric acid etch of the trench mask layer 202b (see col. 3, lines 50-53).

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Khanh Duong whose telephone number is (703) 305-1784. The examiner can normally be reached on Monday - Friday (9:00 AM - 6:00 PM).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Amir Zarabian, can be reached on (703) 308-4905. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 305-3431 for regular communications and (703) 308-7722 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.

KBD
April 8, 2003

AMIR ZARABIAN
SUPERVISORY PATENT EXAMINER
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